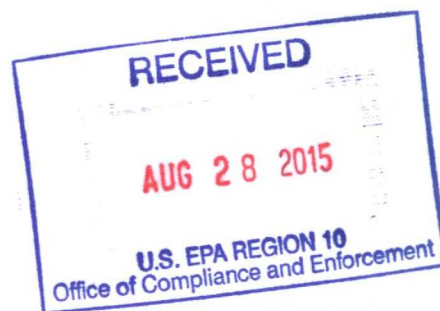


Request 0103

EPA Region 10
Deemed Releasable



TOP/CL/ INVESTIGATION

330733



Investigative Report Amended to include the Initial Data Gathering Date below:

Year	Invest #	Investigation Title	Unit/Area	Date Occurred	Initial Data Gathering
2013	330733	East Flare Detonation	Flare	04/06/13	04/06/13

DRAFT

BUSINESS CONFIDENTIAL
INFORMATION

Investigation Report

East Flare Detonation

Date of Incident: 4/6/13

Investigation Start Date: 4/7/13

Report Date:

Team:

- Geno Stemme, Tony Finrock, Mike Osborne, Renee Majumdar (facilitator),
- Frank Capristo (Brinderson, 3rd party contractor, involved concerning Brinderson work related to the permit)

Executive Summary

During East Flare stack isolation activities on 4/6/13 in preparation for flare tip maintenance, a series of ignitions occurred, resulting in two flash fires at the base of the flare stack. No personnel were exposed to flame or heat during these events, but the potential for exposure was high. During the second ignition event, one operator sustained a first aid injury (sprain) while evacuating the area.

As the maintenance crew was spreading the flange to install a blind, a larger-than-expected flame was seen at the flare tip by a member of the maintenance crew. The maintenance crew was ordered to evacuate the immediate area of the open flange and had withdrawn prior. Three flashes of flame were observed at the 36" flange at the base of the stack of the East Flare.

This report examines the direct and indirect root causes of the flare fire event, as determined by the investigation team by following the Causal Analysis model. The team was directed by management sponsorship to focus particularly on the human systems and work processes aspects of this event, in order to gain insight which could be of value in eliminating future events. The direct physical mechanism of the event was also examined so as to be understood with a sufficient level of certainty, but this study amounted to a much lesser portion of the total investigative effort.

The flare isolation procedure was reactivated prior to use following plant practice for turnaround procedures. The investigation team concluded that the flare event was causally rooted in several failures of the procedure modification and reactivation process, including technical review, change management, approval, and operator training. Other contributing factors were present including: conflicting attitudes and messaging about the operator's role in the review of procedural changes; significant resource limitations because of both planned and unplanned operational events; and miscommunication between the permitting operators and the maintenance crew, which led to an incorrect belief that the system was decontaminated/steam purged. While none of these contributing factors pass the 'causal test', each was identified as a significant missed opportunity to prevent the incident.

The permitting process appears to have been followed appropriately, although interview testimony indicated the miscommunication about flare line condition and contents.

Recommendations by the team include:

- Change PSR procedure review and training practices to increase the emphasis on group engagement.
- Modify structure of procedure update process particularly for substantive changes.
- Clarify and strengthen PSR's decontamination practices to prevent opening of equipment containing hydrocarbon; and to establish specific protocols when this cannot be avoided.
- Expand TOP Refresher training in 2014 to specifically address the employee's part in maintaining awareness of potential hazards even when executing an approved procedure.

The direct mechanism of the first ignition event was determined to be that air was pulled into the natural-gas-filled flare line at the blind location, which created a flammable mixture. When this mixture reached the flare tip, where pilots were lit, the flame flashed down and was ejected from the open flange. The second ignition event is believed to have been caused by natural gas emitting from the flange and finding a nearby ignition source, but this could not be confirmed.

During the maintenance that followed, a hole was discovered in the flare tip "molecular seal". This was determined to be non-causal because the mole seal cannot act as a flame or detonation arrester – the outcome would not have changed had the hole not been present. However, the existence of the mole seal and people's mistaken belief that it had flame arrest properties may have introduced errors during the technical, safety and operational review phase of the procedure modification.

Subsequent to the incidents the flare isolation plan was modified and maintenance work resumed without further incident.

Contents

Executive Summary	2
Scope of Investigation	4
Problem Statement	4
East Flare Shutdown and Process Flow Description	5
Figure 1. East Flare System Simplified Flow Diagram	5
Sequence of Events – 4/6/13 Incident	6
Background Information – Procedure and Scope	7
Cause Analysis	8

Physical Mode and Mechanism of Incident	8
Analysis of Possible Human Systems Contributions	9
Why was the flange at the bottom of the flare stack open?	9
Why did the east flare system from the KO Drum to the flare tip contain hydrocarbon when the 36" flange was open?	10
Why were the pilots lit at the top of the flare when the 36" flange was open?	10
Why did the flare scope team decide that we should blind at the base of the flare before steaming out?	10
Why was the changed procedure authorized?	11
Why did the on-shift operators think the procedure was safe to follow?	12
Observations, Insights, Conclusions	15
Recommendations	16
Appendix	19

Scope of Investigation

The physical mechanism causes of why the detonations happened was only a small portion of this investigation. The remainder of the scope of the investigation was primarily focused on:

- Development of the east flare maintenance and isolation plan
- Decontamination and shutdown procedure review and approval process,
- Communication and understanding of this plan; and
- The execution of this plan.

The investigation was based on interviews of the people involved and is subject to change if more information becomes available.

Problem Statement

Expected:

Equipment has levels of hydrocarbon that are below the required permitting LEL limits prior to opening equipment for maintenance activities.

Actual:

In the process of installing the blind at the base of the flare, there was enough hydrocarbon to increase the flare flame at the flare time as well as have an uncontrolled flame front inside the flare riser.

Impact:

- Significant Near Miss
- First Aid of operator during second evacuation
- Delay of east flare outage due to additional time to understand incident and adjust plans accordingly

East Flare Shutdown and Process Flow Description

The Flare has a series of headers that route flashed vapor from each processing unit to the plant's three Flare systems. The headers originate at the knock out (KO) drums within each process unit and routes these products from the Unit KO drums to the three Flare systems. Each Flare system includes a KO Drum (19NC1/2/3), a Seal Pot (19NC4/5/6) and a Flare Stack (19NF1/2/3).

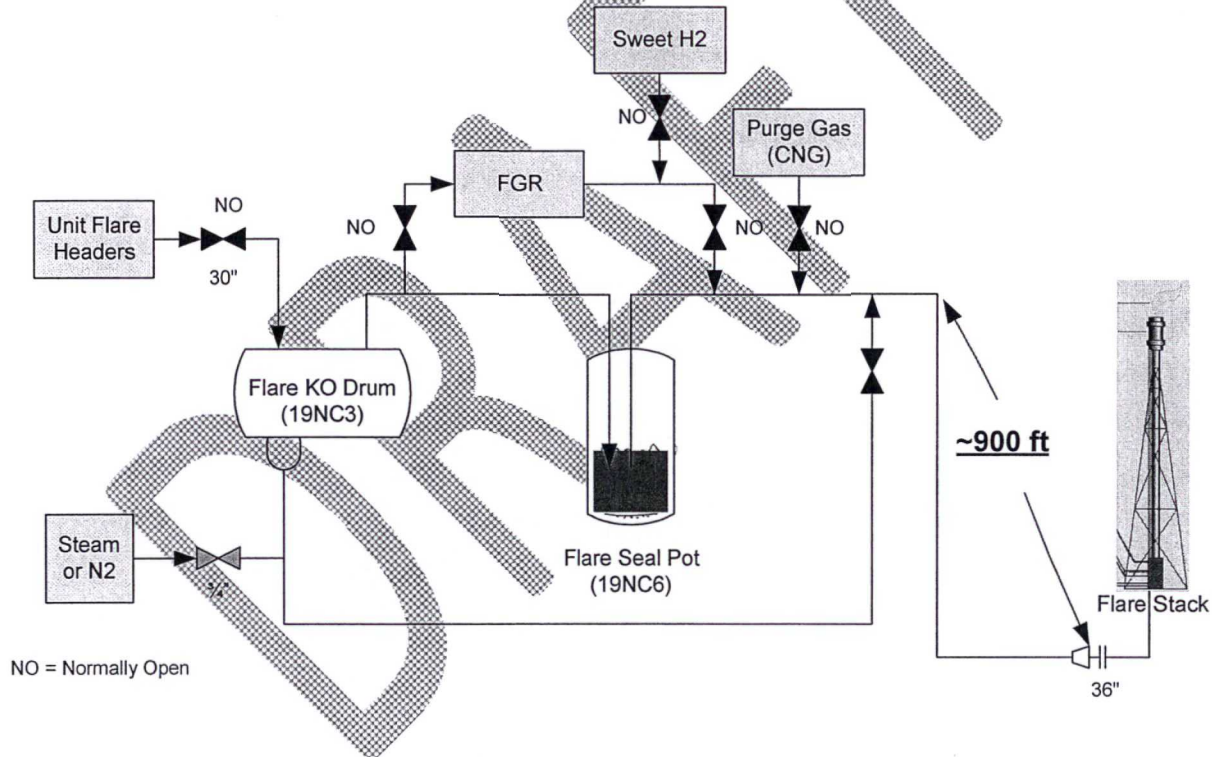


Figure 1. East Flare System Simplified Flow Diagram

East Flare Stack (19NF3) design varies from the North and South Flares in that it has an inline Molecular Seal with external drain piping and a Muffle Burner Tip. The Molecular Seal's purpose is to reduce the amount of purge gas flow required to prevent Oxygen intrusion in the system through the flare tip. The Muffle Burner Tip's purpose is to reduce the ambient noise during normal Flare Stack operation.

The vapor from the header first enters the KO Drum (19NC3), where any liquids drop out and are routed to slops tank 105. The gasses are routed to the Flare Gas Recovery (FGR) unit and downstream of the Seal Pot (19NC6). This Seal Pot provides enough back pressure to the system to force the gasses back to the FGR. Once past the seal pot, the vapor travels down the line, through the Molecular Seal and out of the Flare Stack (19NF3), where it is incinerated at the Muffle Burner Tip.

Sequence of Events – 4/6/13 Incident

Times were determined by a combination of interviews, times denoted on the procedure or captured in the computer (permit times, radio calls) and are only approximate.

- 0900 – All talk announcement by STL that E. Flare is being shut down for maintenance.
- 0936 – Operations verify that 24' ball valve between old and new flare lines is open.
- 1000 – Operations line up FGR and Sweet H2 flare to the South Flare and block in these lines on the East Flare.
- 1730 – Brinderson Foreman checks in with operations for permit, he is asked to come back as they are "still purging."
- 1800 – Ops make a procedure change and write in to block new 19HS70 fuel gas purge valve. 19HS70 and Natural gas purge valves are both blocked in.
- 1815 – Ops finish physically locking out 19HS70 and Natural Gas purge valves.
- 1828 – Safe Work permit printed.
- 1930 – Brinderson crew comes back for Safe Work permit. They review LOTO and isolation drawing with Ops. Permit issued.
- 1930 – 2008 – Brinderson crew working to spread 36" flange, they were able to spread it 1.5-2" apart.
- 2008:29 – Coastal (another 3rd party contractor at job site) radios, "Is there supposed to be flame coming from the top?"
- 2008-2010 – Crafts evacuate the scaffold
- 2008:46 – Brinderson foreman radios, "Serious flame, are we all good?"
- 2008:50 – Ops reply, "Everything is block out and we're checking everything, go ahead."
- 2010:39 – HTU #2 call Alky 2 on the radio asking about and issue, reply states "no, they're concerned about the pilots."
- 2021 – Brinderson foreman left job site to gather equipment.
- 2022 – 2030 – Ops & crafts have discussion about increased flame out of tip ~50ft from flange.
- 2030 – Sucking noise followed by 3 bursts of fire out of flange, all personnel evacuate the area.
- 2034 – Craft workers radio foreman to meet near economizer (almost ~1000 feet away from flange area).
- 2036 – Lead Outside Operator (LOO) gives instructions to other outside ops to hook up steam to KO drum and then later N2 instead.
- 2036 - 2104 – Ops gather fittings and lay hose to manifolds.
- 2105 – A good flow of N2 reported achieved.

- 2111 – A report on the radio goes out that ops are increasing N2 pressure.
- 2111 – 2113 – LOO's go to flare stack to shutdown the still running light plants. 1 light plant is shutdown before flash occurs again.
- 2113:59 – Radio call from ops goes out, "What was that guys?"
- 2114:02 – Radio call from ops, "We just had another one."
- 2114 – Flash at 36" flange seen, a rumble and heavy smoke seen at flare tip. A detonation is also heard at the flare tip.
- 2136 – Ops shuts off pilots
- 2146 – Operations inform Maintenance the no more work will be allowed for rest of night.
- 0000 – East Flare seal pot level is increased to 100%
- 0300 – Crafts close and bolt 36" flange shut.

Background Information – Procedure and Scope

This section is intended to convey information the team considered as related to the development of the scope of work and shutdown procedure.

- May 11, 2012 – East Flare molecular seal (mole seal) drain (external piping to flare) leak discovered.
- May 16, 2012 – MOC M2012378-001 was created with Tech Assurance to operations that flare could continue to operate with mitigation of mole seal drain leak.
- December 1, 2012 – Operators report an abnormal situation, flame was noticed at base of flare tip.
- December 5, 2012 – MOC was extended to allow for flare operations to continue with interim measures in place until November 2013 (when a flare outage was scheduled).
- January 1, 2013 – In anticipation of flare shutdown work and 2014 turnarounds, operator begins Special Assignment (SA) role for Alky 2/Flare shutdowns (this operator was to plan the operations portion of the work and develop procedures for the flare shutdowns and the 2014 Alky 2 turnaround).
- January 29, 2013 – Meeting held for flare shutdown prep work.
- February 13, 2013 – SA leads flare procedure/isolation planning meeting for all flare work to be performed.
- February 25, 2013 – Intrusive maintenance on South Flare seal pot was added.
- March 6, 2013 – All work scopes for North, South and East flares are finalized.
- March 21, 2013 – Unit Manager (PUM), Operations Maintenance Specialist (OMS) and the SA meet to discuss flare preparation status.
- March 24, 2013 – March 27, 2013 – FCCU is shutdown and FGR goes through an upset and is shutdown.
- March 27, 2013 – Procedures for N/S/E flares are authorized.
- March 28, 2013 – April 2, 2013 – Procedure training is held with operators.

- April 3, 2013 – MOC M2013298-001 is made Ready for Startup (RFSU) on flare procedures and OMS/PS/SA conduct a final readiness review meeting.

Cause Analysis

Physical Mode and Mechanism of Incident

Prior to opening the 36" flange, operators blocked in the flare line and flare stack so that it was isolated from refinery flare gas sources (~0900). Since the maintenance crew was not available to put in the blind until after 1800, the natural gas purge injection was left in service to sweep the line and stack from a location downstream of vessel 19NC6 toward the flare tip, a practice which prevents air intrusion at the flare tip. Isolation points and the natural gas injection point were consistent with the reactivated procedure 19TAFLARE004. This lineup was maintained until the operator went to lock and tag this valve. He then issued the permit for the flange opening and blind installation work.

In accordance with the reactivated procedure, the flare pilots remained lit during the sweep (past practice) and during the opening of the flange. The investigation team believes that the state of the flare line immediately prior to opening the flange was as follows:

- The flare line and stack contained natural gas (methane, ethane) and only trace amounts of anything else.
- The pressure in the line and stack were slightly below atmospheric pressure because of draft induced by the heat of the burning pilots at the flare tip and the height of the flare stack.

By opening the flange in preparation for insertion of the blind, the maintenance crew created a gap in containment which allowed the natural gas atmosphere inside of the flare line to mix with surrounding air. Because the pressure in the line was below atmospheric pressure, this mixing occurred inside the flare line (atmospheric air was inducted). Creating a gap in containment at the base of the flare stack also had the effect of "breaking the vacuum" in the line (the pressure in the flare line at grade level increased as atmospheric air flowed in through the gap). This allowed gases to flow toward the direction of the source of the draft – toward the flare tip. The result of this was observed by the maintenance support crew at grade – a large flame at the flare tip as the contents of the flare stack (natural gas) was expelled from the flare tip and burned, ignited by the pilots.

During this time, air continued to be drawn into the gap at the open flange, and within the pipe mixing of air and natural gas continued. As this process continued, a mixture of air and natural gas began to migrate toward the flare tip, still drawn by the draft of flame at the tip. As the process continued, the concentration of oxygen in the mixture increased, eventually reaching the upper limit of flammability of natural gas. After a period, a sufficient amount of air (and oxygen) had been drawn into the stack to allow a continuous path of combustible gas from the flare tip to (or nearly to) the gap at the open flange. The flare flame propagated through the flare tip and molecular seal into the flare stack, and either immediately or very shortly after, down the stack toward the flange.

The flame front moved much faster than the material was moving toward the flare tip, so combustion products were generated more quickly than pressure could disperse up the stack. As a result, pressure inside of the line rose nearly instantaneously, resulting in a "puff" of hot gases and flame as the pressure escaped through the open flange. Three of these "flame puff" events occurred in rapid succession as pockets of gas within the flammable range were ignited and consumed in the area of the flange.

At approximately 2114, there was another flash at the flange opening. This is believed to have been ignited by a light plant (portable generator with lights) which was running in the area, and to have flashed into and up the stack toward the tip, rather than the other way around, evidenced by the order of events recalled by eyewitness interviews.

Analysis of Possible Human Systems Contributions

Why was the flange at the bottom of the flare stack open?

On the evening of 4/6/13, the night shift Brinderson maintenance crew was scheduled to install a slip blind on the 36" line at the base of the East Flare Stack.

Per the PSIA008 "Permit to Work Instruction" Personnel receiving permits have the responsibility to "identify the equipment and work location and comply with all conditions stated on the permit. Personnel shall then sign the permit to acknowledge understanding of all conditions and limitations of the permit. All work crewmembers have an individual responsibility to read and understand the conditions of the permit." This is accomplished by a briefing (job walk) prior to issuance of the permit. The joint job walk is a detailed review of the physical jobsite by the permit issuer and permit receiver in order to come to a clear understanding of work scope, equipment conditions, and job site conditions.

Once the Lead Outside Operator (LOO) and the Brinderson crew completed the joint job walk, a Safe Work permit for fresh air blinding on the out of service line was issued. A gas test was to be performed once the system was opened as there were no test points for operations available to validate the contents of the line prior to opening of the system.

PSIA010 "Control of Hazardous Energy" Section E - Blinding, Item #2 for installing blinds states:

"Prior to issuing the permit, the Equipment Owner and Protected Personnel shall conduct a joint job walk. The Equipment Owner shall clearly identify the line and/or flange(s) that shall be blinded and show how they have been isolated and depressurized"

There is no requirement in the PSIA010, requiring operations to decontaminate the equipment or line of process prior to issuing a permit for blind installation. Since operations had reached the step in the shutdown procedure for blind installation and the LOTO and isolation packages were complete, operations issued the Safe Work Fresh Air blind installation permit as their work process dictates.

**BUSINESS CONFIDENTIAL
INFORMATION**

Why did the east flare system from the KO Drum to the flare tip contain hydrocarbon when the 36" flange was open?

The 30" valve at the inlet to the east flare systems Knock-Out Drum (19NC3) was closed on dayshift. A natural gas purge is normally flowing when the flare system is in service to keep a positive flow constantly moving in the right direction. When maintenance crew representatives checked in at the beginning of the shift, they were told that there was still some isolation to be done and the purge was still going. Per the team's interview, the foreman of the crew understood this as meaning a steam purge had yet to be shut off (when in actuality it was the purge gas that continued to flow into this system). All possible energy inputs into the system including the natural gas purge were blocked prior to the permit being issued.

The blocking of all inlets into the system with an open ended line (i.e. the flare stack) ensured there was minimal to no pressure on this system. However the fact that an inert purging medium had yet to be administered coupled with the very large capacity of this system (in essence a "low spot" below the height of the flare tip), created a situation by which a large volume of gas (a combination of natural gas and residual flare gas) was present in the pipe system when the 36" flange was opened.

Why were the pilots lit at the top of the flare when the 36" flange was open?

Historically when this system is decontaminated using steam to push out any residual flare gas prior to blind installation, the pilots are left going in order to ignite and burn harmful vapors before being released to the atmosphere. This is required by the environmental permit.

Per the procedure, the pilots were still lit in anticipation of the steam out of the flare stack downstream of the blind, which was to occur after the blinding per the revised procedure. It was also mentioned that the flare scope team discussed an occurrence during a previous turnaround when they had trouble re-lighting the East Flare pilots, taking 2 days before they were lit again.

The step to inject the steam was numerically the same as it was in the procedure used in the previous turnaround, but the step had been moved to be done after the 36" blind was installed in order to steam out only the flare stack as opposed to the entire system as executed in the past.

Why did the flare scope team decide that we should blind at the base of the flare before steaming out?

It was mentioned during interviews that it was believed that when the flange was opened prior to steam out, an updraft would be created by the lit pilots ensuring that flow would move in the correct direction up the flare stack.

It was also mentioned in several interviews that some thought the molecular seal would restrict a back flow down through the flare tip, which would negate the possibility of O2 backing down into the system. Others mentioned during interviews that the molecular seal was thought to have flame-arresting properties, which it does not.

The investigation team believes it was the combination of thinking the flow of gas in the flare would be up the stack and that the molecular seal would protect from back flow that contributed to the team approving the new isolation approach.

Once the blind was installed, operations could commence with steaming out only the flare stack thereby greatly reducing the volume of steam required for decontaminating the remaining system before the flare tip work. Minimizing the steaming process was mentioned in several interviews as a main consideration due to the odor complaints incurred during two previous shutdowns when the entire system was steamed out (from the KO Drum to the flare tip). Most interviewed first commented that they had a desire to avoid an environmental incident (via odor complaints).

Some interviewed also said there was a concern that steaming out the flare line could activate pyrophoric materials, and induce a reaction when the flange was opened, introducing a possible ignition hazard. Standing Instruction A.070.1 Pyrophoric Materials details the hazards associated with this material.

Why was the changed procedure authorized?

All turnaround procedures at PSR are retired after use and reauthorized before being used again. This policy assures that each procedure is reviewed before each use, which is important because each use tends to be unique in some way.

The updated procedure 19TAFLARE004 was authorized following the procedure update standing instruction, PSIA063. The standing instruction allows for use of a hardcopy signed cover-sheet form, the "Field Deviation / Procedure Update Form"; this approach was used in this instance.

After update of the procedure, it was hand-carried to the various signers, who consisted of one technical reviewer, two qualified operators, an HSE representative, and the authorizing management representative. Two irregularities were noted in this process:

1. The SI and the form specify that two technical reviewers are required (only one was obtained).
2. The authorizer was the STL. While this is acceptable according to the SI under some circumstances, the Production Specialist was intended to be the authorizer if available. The wording on the form is somewhat unclear on this point.

Each of the reviewers who signed described their process of review differently:

- One reviewer explained that review was very brief and that the expectation was that the procedure had been reviewed by a different set of individuals. The expectation was based upon conversations the reviewer had with the author of the updates.
- Another reviewer had completed a full read-through and did identify some shortcomings, which were addressed prior to signature.

**BUSINESS CONFIDENTIAL
INFORMATION**

- Another reviewer also identified shortcomings but had an expectation that additional steps to address these would be carried out even though they were not explicitly mentioned in the procedure.
- Another reviewer explained that their review is limited to their area of expertise and did not include evaluating process safety or decontamination aspects.

After the management authorizer had signed the Field Deviation / Procedure Update Form, a MOC was created in KMS to capture the date of authorization, as described by the standing instruction PSIA052 -

Management of Change.

Why did the on-shift operators think the procedure was safe to follow?

The investigation team concluded that only logical reason why the procedure was followed was that it must have been seen to be safe to use, even if for different reasons by different individuals. The counter deduction being that operators did not believe it was safe, but followed it anyway; there was no evidence for this. However, based upon interviews with operators who were present or involved, two theories emerged:

- The procedure was known to have been through the update process AND operators believed that this process was robust, and if followed would provide a safe procedure.
AND/OR
- Operators believed the new procedure to be largely consistent with the old procedure, and the old procedure had been proven safe.

Each of these is treated separately below. Note that this is an explanation of two possible theories that, if true, would explain why the procedure was created, approved, and followed. Neither of these theories were specifically, fully explained specifically by any interviewee.

The procedure was known to have been through the update process, AND, operators believed that this process was robust and if followed would provide a safe procedure.

This describes how operators who *understood the significance* of the changes could still have had confidence in the procedure.

The updated procedures were presented by the SA trainer, who described the update process and the review steps required. The procedures had been initially marked up during procedure update review conversations held in January and February of 2013. These conversations included a broad range of experienced individuals from engineering, maintenance, and production. The large number of people involved may have lent an additional feeling of confidence in the results.

After technical review, the procedures were updated by the SA and submitted for review and authorization using the "Field Deviation / Procedure Update Form". This process required further review by technical, production, HS&E, and management representatives. (See "why was the changed procedure authorized", above). The various people involved in the creation and review of the procedures were well respected.

The procedure review process was generally felt to be robust: It had been used with good results in the past. Although there were some anomalies, the update process was largely followed as described in the standing instruction.

Finally, the investigation team believes that over time, PSR has sent mixed messages about the role of the operator in regard to procedure review and training and that this has reduced the depth and detail of reviews which experienced outside operators give to procedure changes.

"PSIA063 – Operating Procedures" states that the user of a procedure is responsible for "*suggesting corrections and improvements in a prompt and timely manner*" and "*constructively participating in the operating procedure review process*". During interviews, some operators shared their belief that Production management has indicated that an operators signature on the trip sheet during procedure training and review, denotes that they understand the content of a changed procedure – not necessarily that they agree with it. This approach tended to move the focus away from active group discussion and the resolution of concerns.

This distinction of the context of the signature requirement is believed to have been developed due to previous occasions in which disagreement with aspects of a procedure being reviewed resulted in a hesitancy of some operators to sign the training sheet. Missing signatures impede the implementation of a procedure which in turn could hold up the associated project or work from moving forward. The resulting disruption of time sensitive planned work had at times created contention with those impacted. The distinction has become the topic of regular conversation, and many people in both operator and staff ranks are aware of the distinction.

The PSM legal requirement regarding changes to procedures is that the change is communicated to the operators and the training is sufficient that they understand what the change is. In this case, the operators were indeed informed and in some cases, there was a discussion about why the procedure was being changed (for example, to reduce steaming to prevent odor and noise issues). However, the method of the procedure review was cited by several interviewees as being contributory in their view to the ultimate outcome.

The investigation team believes that the expectation for operators to "understand and sign" modified procedures impacted how operators reviewed the east flare shutdown procedure and viewed the procedure during use. In interviews,...(I can't remember the data clearly enough to write more –help!)

- OR -

Operators believed the new procedure to be largely consistent with the old procedure, and the old procedure had been proven safe

This describes how some operators may have failed to recognize the significance of the changes, even though they participated in training on the revisions.

**BUSINESS CONFIDENTIAL
INFORMATION**

1. Operators were familiar with the 'old' flare decontamination procedure, in which the flare was steamed from the KO Pot to the flare tip with pilots running prior to blinding. This process had been executed several times in the prior eight years.

It is a commonly observed psychological phenomenon that people process information through expected patterns. We see what we expect to see. When reviewing written material and the first few observations reinforce what we already know, it is likely that the familiar pattern of information will become more embedded, inducing someone to become much less alert to subsequent changes. This is not a mistake in the way the impacted operators were thinking; rather it is the way people commonly process information, unless one is actively trying NOT to think in this way.

It can be observed when comparing the old procedure and the new that, for example, the steaming element is essentially the same but in a new location within the procedure. If one was looking for the element of steaming, it would be found. One operator who signed the authorization sheet stated (in paraphrase) that he thought the steaming element did come before the blinding step.

2. The manner in which the material was presented likely had an impact on the outcome in several ways:
 - Due to unit recovery efforts caused by the FGR upset, the SA Trainer was unexpectedly reassigned to the unit to work an outside operations position during the week he was expected to provide procedure training and retrieve the required signatures. As a result he was forced to 'chase down' people to perform the training. This caused training to sometimes be hurried and brief.
 - The format of the training discussions varied from one-on-one to small group, and were held on shift in operator shelters, at the console, or in office environments.
 - Six updated and reactivated procedures were bundled to be reviewed as a single training packet.
 - Four were minimally changed from prior versions.
 - One was the South Flare decontamination/shutdown which drew more attention due to the greater risk associated with entry work. This put further constraints on the time allowed for the review of the East Flare procedure.
 - The SA Trainer presented the changes on the East Flare as minor, because he believed this to be the case. Specifically, he said in interview that he summed up the change as moving the location of the first blind and steam input. He had participated in the technical review discussions and had confidence in the outcome of those discussions.
3. The flare shutdown and maintenance work was considered to be a "Pit Stop", which is different than a Turnaround (TA) shutdown. The distinction changes who manages the maintenance planning and execution as well as how the reauthorized shutdown procedure is reviewed by operations.

**BUSINESS CONFIDENTIAL
INFORMATION**

Typically for TA's, a production staff member leads the procedure review step by step with at least one full, but usually two full operating teams at the same time. This is done outside of operating shift schedule. "Pit Stops" are approached more akin to running maintenance where discussions are much less formal and may resemble a normal shift pass-down discussion between operators, depending on the scope of work. The investigation team concluded that the "Pit Stop" approach structurally allowed the method by which the procedure was shared with operations (as described in 2 above).

The overall effect of these factors could help create the perception that the changes to the East Flare Shut Down procedure were indeed minor and limited to a change of location for blinding and the steam injection point, limiting everyone's ability to interview to prevent a safety issue.

Observations, Insights, Conclusions

Observation	Several operators have stated they expected to steam the flare in the procedure before maintenance was given control of the flare.
Insight	There was a step in the procedure after installing the blind at the bottom of the stack to begin steaming.
Conclusion	Ops were so used to the "old" procedure they read what they expected to see.

Observation	The procedure change review quality is set by the level of expertise of the people involved.
Insight	Even seasoned operator counted on the procedure review team (technical and otherwise) to deliver a safe and thorough plan for maintenance.
Conclusion	The signing off of the changed/ updated procedure gave a false sense of security that all aspects of the plan were reviewed thoroughly so that any process / personal safety aspects were already caught.

**BUSINESS CONFIDENTIAL
INFORMATION**

Recommendations

Below is a summary of the recommendations and action plan. Full commentary can be found in the embedded file in Attachments.

1. Unit Training Revamp	
What cause to address	PSR currently expects that training signatures from operators only indicate understanding.
Recommendation	<p>Reinstate and apply the practice of procedure review and training as a group exercise whenever possible and appropriate. This includes reactivation of Turnaround Procedures, substantively modified procedures, and regularly scheduled procedure reviews that are required to occur within every 3 years.</p> <p>The current practice for operator review of and training on procedures varies depending on the circumstance, area and scope of change, from individual review-and-sign to 1-to-1 review with a trainer to group review during a scheduled training session . While individual review may be appropriate in some cases, the team believes that the best quality learning occurs in a group discussion scenario. This opportunity for knowledge transfer and reinforcement of safety critical techniques should be exploited whenever possible.</p> <p>In particular, the team feels that formalizing training on reactivated T/A procedures would greatly improve people's understanding of these less-often-used procedures. Currently this method is used for "real" turnarounds, but not for "pitstop" turnarounds, which are executed under a different management structure.</p>
Action Plan	<p>Action: Draft and distribute communication to Production and support organizations clarifying expectations, responsibilities and accountabilities for procedure review and approval. Who: Carmen Cuartin When: 11/1/14</p> <p>Action: L&D solicit feedback via surveys of trainers and training recipients regarding the effectiveness and engagement of the current processes required by PSIA036. Basis feedback, recommendations to be submitted to Production Manager with agreement on follow up actions to be documented in Fountain for tracking to completion. Who: Janita Aalto When: 11/1/14</p>

**BUSINESS CONFIDENTIAL
INFORMATION**

	<p>Action: L&D review current procedure refresh process, particularly as related to group review of emergency, shutdown, and startup procedures, and provide recommendations for improvement to Production Manager.</p> <p>Who: Janita Aalto</p> <p>When: 11/1/14</p> <p>Action: Audit implementation and effectiveness of revisions to PSIA036 and/or changes to procedure review/training process associated with above action.</p> <p>Who: Carmen Cuartin</p> <p>When: 12/31/2015</p>
--	--

2. HEMP and MOC of Operating Procedures	
What cause to address	The technical review team for the procedure change believed that the 36" flange at the base of the flare stack was a safe location to install a slip blind prior to steam-out / system decontamination.
Recommendation	<p>It is recommended to rework the PSIA052 -Management of Change standing instruction so that the change process for operating procedures, to consider the following:</p> <ul style="list-style-type: none"> - Defines the minimum reviewer set across all applicable disciplines. - Assures that reviewers are competent to perform their role. - Provides specific responsibility for evaluation of process safety impacts to one individual (in addition to the general responsibility which all reviewers must feel to act with awareness of process safety impacts). - Provides a structured, standardized, and vetted minimum set of guidance questions which serve to assure that the review process hits all of the key assurance areas. - Documents the discussion occurred, providing both technical and work process accountability. - Assures that any reviewers who miss initial discussions are still accountable to provide input. - Assures that operating procedure MOC, as a HEMP-mandated critical

	activity, where the HEMP site process owner is ultimately accountable.
Action Plan	<p>Action: Review existing operating procedure change process under both PSIA052 -Management of Change and PSIA063 – Operating Procedures, including standing instruction and MOC requirements, from a PSM standpoint and provide recommendations to L&D/Production organization for improvements.</p> <p>Who: Steve Williams</p> <p>When: 6/30/14</p>

4. Proving out isolation and decontamination of prepared equipment/systems.	
What cause to address	Crafts expected to encounter only residual hydrocarbon.
Recommendation	<p>We recommend a separate solution development team gather to develop a recommendation, as follows:</p> <ul style="list-style-type: none"> • Goal: ensure our execution of isolation and decontamination procedures is robust • Include representatives from Shell maintenance, resident contractors and operations (consider shop stewards). • Meet for a ½ day to full day facilitated workshop • Develop 1 recommendation that can be implemented across the site • Describe how to implement it for sustainable change • Focus on communication effectiveness
Action Plan	<p>Action: Charter team consisting of USW leadership, Maintenance shop stewards or similar, and HSSE support to develop training, communication or engagement with PSR operations and maintenance personnel (including core contractors) regarding the criticality of ensuring and communicating positive isolation and decontamination of equipment at the point it is handed off to maintenance personnel.</p> <p>Who: Michael Burke</p> <p>When: 11/1/14</p>

**BUSINESS CONFIDENTIAL
INFORMATION**

5. Extended Learning - Systemic Belief	
What cause to address	Systemic Beliefs: "if I do my part of the work process (procedure update review), someone else will catch an issue (or already did) and we'll still get the results we want (the procedure will be safe)"
Recommendation	<p>Learning Across the PSR Organization (learning is the only way to shift a belief)</p> <ol style="list-style-type: none"> 1. RLT – 1 session (complete in August) 2. ELT – 2 sessions (complete in September) 3. Sitewide
Action Plan	<p>Action: Include this incident and its associated learning in the 2014 TOP Refresh training.</p> <p>Who: Joe Solomon</p> <p>When: 9/30/14</p>

Appendix



Visio-flare cause
tree.pdf



Visio-flare
timeline.pdf



131030 East Flare
Investigation Recomm

**BUSINESS CONFIDENTIAL
INFORMATION**